

A N
A C C O U N T
O F S O M E
E X P E R I M E N T S
O N
M E R C U R Y,
S I L V E R A N D G O L D,
MADE AT GUILDFORD IN MAY, 1782.
IN THE LABORATORY OF
J A M E S P R I C E, M. D. F. R. S.
TO WHICH IS PREFIXED
AN ABRIDGMENT OF BOYLE'S ACCOUNT
OF A DEGRADATION OF GOLD.

In nova fert animus mutatas dicere formas
Corpora——— OVID.

Plus Ultra.

O X F O R D:
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IMPRIMATUR,

S. DENNIS,

VICE-CAN. OXON.

JULY 9, 1782.

TO
MARTIN WALL, M. D.
PRÆLECTOR OF CHEMISTRY
IN THE
UNIVERSITY OF OXFORD,
DISTINGUISHED BY THE LIBERALITY OF HIS SENTIMENTS
AND BY HIS EFFORTS FOR THE PROMOTION OF
CHEMICAL KNOWLEDGE,
THE FOLLOWING NARRATIVE
AS A PUBLIC TESTIMONY OF RESPECT
AND A PRIVATE MARK OF FRIENDSHIP
IS INSCRIBED
BY HIS OBLIGED FRIEND AND SERVANT

THE A U

WE may among other things learn from it this lesson, that we ought not to be so forward as many men otherwise of great parts are wont to be, in prescribing narrow limits to the power of Nature and Art, and in condemning and deriding all those that pretend to, or believe, uncommon things in Chymistry, as either Cheats or Credulous.

Boyle.

INTRODUCTION.

A FREQUENT perusal of ancient chemical writers, and an early attachment to the metallurgic branches of Chemistry, inclined the author of the ensuing narrative to believe that the wonders related in books at present little read, though frequently exaggerated, had at least some foundation.

The phenomena which he continually met with in the pursuit of his experimental enquiries contributed greatly to strengthen this opinion: He found also, that some discoveries supposed to be modern, were really recorded in very ancient writers; but in terms so obscure, that the fact must rather be applied to explain the description, than the description to illustrate the fact.

The positions of the Spagyric Philosophers respecting metals, seemed to be very easily reconciled with the notions of more modern chemists.

That their inflammable principle in modern language, or their sulphur in that of the ancients, is the same in all, is now universally allowed.

That the imperfect metals had a saline principle, the antient Chemists knew, or believed; and according to Boerhaave denoted it by a cross attached to their characters, as in γ η ϕ , and the like. The most excellent of modern Chemists, Professor Bergman of Upsal (from the Experiment of the acute Scheele who has demonstrated an actual acid in arsenic) suspects an acid, at least a saline basis to be common to all the imperfect metallic substances.

Of their Earths, most have allowed the diversity; but specific gravity being usually considered as the least dubious mark of real identity between two bodies otherwise dissimilar, it seemed probable that Mercury and Gold had a basis nearly alike.

The remarkable analogies between the habitudes of Silver and Mercury, to chemical solvents and other agents, are known to every Chemist.

These, and a thousand other analogies, too obvious as well as too minute to relate, occurred in a course of incessant experiment, in which an ardent curiosity involved the author at a very early period: and which, in consequence of his being partly engaged in instructing others, and from various causes not material to the publick, he had occasion to compare with passages in books, containing “all such reading as was never read.” Among this mass of unformed matter, where opinion fought with opinion, and *Chaos judged the strife*, the specious glitter of some broken gems, allured him to prosecute his search, and, if possible, dive to the bottom; the turbid stream did not permit

permit his view of its utmost depths, but he returns to shew that he has been below the surface, and not quite in vain.

To the Chemist it is unnecessary to hint at more analogies; to others it would be useless: Allusions to Chemical facts to the latter would be unintelligible, it must therefore be only to the Philosophers *by fire*, that he can address the former part of this Introduction; for who can teach a science in a page.

Of facts however, all men of common sense are equally judges.—Having therefore partly assigned his reasons for instituting the enquiry, he now proceeds to the attestation of its result.

Exclusive of the confirmation which this will receive from reflecting on the difficulty of deceiving men, even of common sagacity, as to a fact which passed before their own eyes; the testimony at present offered, possesses peculiar advantages.

The Characters of many Spectators of these processes, whose Titles adorn the following pages, are too well known in the political or literary world, to require in this place any illustration.

Among the remainder, some,—members of a Society, whose object is to investigate truth by experiment, were too perspicacious to let error escape undetected: and the

sacred function of others, must have impelled them to mark it, if voluntary, with public reprobation.

In his first Experiment, indeed, the Author had only time to request the presence of Captain Grose, a gentleman advantageously known to the Antiquarian world by his researches and publications; that of the Rev. Mr. Anderson, a Clergyman residing near Guildford, well versed in Experimental Philosophy, and studious of its Chemical branches; and of Mr. Russell a Magistrate of the Place and a person from his technical employments conversant with the appearance of the precious metals, well acquainted with the usual operations on them, and with the methods employed by Artists for ascertaining their commercial value.

As the first process was quickly mentioned, more spectators were present at the later ones; and the seventh was made before a company so respectable, as to leave the author little to wish for in point of testimony.

The Experiments however which it is the purpose of the following narration to relate, are of a nature so very uncommon; and tend to establish an opinion so generally exploded, that to procure them credit, requires the most respectable attestation.

The place in which these Experiments were made being at a considerable distance from the Capital, would not admit of their being seen by many to whom the Author would otherwise have been happy in exhibiting them.

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The whole of the materials producing the extraordinary change in the metal employed, was expended in performing the processes which are now to be related; nor can the Author furnish himself with a second portion, but by a process equally tedious and operose, whose effects he has recently experienced to be injurious to his health, and of which he must therefore avoid the repetition.—The repetition indeed would avail but little to establish the facts, or gain belief. That more would believe if more had been present, is indeed true; but as the Spectators of a fact must always be less numerous than those who hear it related, the majority must at last believe, if they believe at all, on the credit of attestation.

Previous to this publication the Author has had frequent opportunities of hearing the opinions of many concerning its subject. Some say that they cannot account for the Theory of the process, and *therefore* that the fact is not true. Others ask, if it be true, is it profitable? Illiberal minds suggest that the whole was a trick, and without knowing or enquiring what evidence it rests on, modestly call the Author a knave and the Spectators fools:—And some Heroes of incredulity, declare that they would not believe it though they saw it with their own eyes and touched it with their own hands.

To prejudice, avarice, or illiberality, perhaps no answer will prove satisfactory: But of the candid and impartial he ventures to ask, by what arts of deceit Mercury can be prevented from boiling in a red heat; as in Exper. II.

or

or when actually boiling and evaporating, it could be almost instantaneously fixed by addition of a substance not above 1. 480th. of its weight as in Exper. III.

Metal might (though not easily before twelve or fourteen Spectators) have been secretly conveyed into the crucible, but this will not account for the event of Exper. IV. and V. where the Silver was enriched with a quantity of Gold eight times larger than the weight of powder projected, and yet the absolute gravity of the mixed mass remained the same, or rather smaller, than the original weight; which could not have happened had any undue addition been made. He may further ask (though this is not properly an argument with the public at large, but only with those who know his situation) what could induce him to take such laborious and indirect methods of acquiring sinister fame: possessed as he was of total independence, and of Chemical reputation.

The Author is too well aware of the strength of prejudice to be at all sanguine in his expectations of receiving credit; but the curiosity of the public has been so much excited, and his character so rigorously examined, that in justice to himself and compliance with them, he offers the following succinct account of his Experiments. An account which was read over to the respective witnesses of each experiment, and of which he now publickly, as before privately, requests their confirmation, without the slightest fear of contradiction, or dissent.

He has endeavoured to give every possible sanction to
his

his processes, by subjecting them to the minute inspection and cautious examination of the spectators; whose rank and discernment confer as much honour on him as is reflected on themselves by their liberality and candour.

Whatever may be the opinion of the publick, it is previously necessary that they should have the facts laid before them. And though he would be most happy to meet with belief, he shall not be surprized if he fails of obtaining it.

With confidence therefore in his own integrity and reliance on their candour, he waits their decision, not void of solicitude, but without trepidation: the more confirmed by the recent honours with which the University to whom he owes his Education, have crowned his Chemical labours.

Her favours he thus publicly mentions, from a better motive he hopes than vanity; by them his scientific and moral Character is placed beyond the limits, at least of vulgar scrutiny: and he must ever remember with respectful gratitude, that she enlarged her institutions, to place him among her graduates, at the instance of her Medical Professors and with approbation of the Academic Senate.

A B S T R A C T
O F
BOYLE'S HISTORICAL ACCOUNT
O F A
D E G R A D A T I O N O F G O L D.

AS every fact becomes more probable in proportion to the number of similar instances, it may not be improper to prefix to the following relation, a concise account of the celebrated experiment of Boyle, on Gold.

It would have been easy to collect from books, particularly from the notes on Boerhaave's Chemistry, under the articles History of Chemistry, and Metals, many narratives of changes of metallic bodies, *specifically* similar to that of our principal subject: i. e. of not only a change, but a *melioration*. Boyle's experiment, resembles ours, *generically* only; for it was a change, but not a melioration: yet its consequence being to debase the metal, it goes towards the proof of a metallic transmutation.

Boerhaave's work is in almost every one's hand; quotation therefore from it would be superfluous: the Works
B of

of Boyle are now less frequently read ; and his historical account, which to use his own words, is really, “ a *strange chymical narrative* ” was so much in point, that an abridgement appears in this place without impropriety.

An *abridgement* rather than a transcription was attempted, since from the quaintness of Boyle’s Stile, his own narrative would perhaps make no favourable impression on the ears of modern readers.

It much resembles the massive furniture of “ *other days* ” made cumbrous by its own ornaments. — Yet perhaps many would more willingly have perused the relation in its original form, as we view with pleasure the soften’d day, through——

“ Storied windows richly dight,
Casting a dim religious light.”——

For the gratification of such, are reserved some fragments of this work of the Venerable Father of English Philosophic Chemistry : these, to use the words, at least the thoughts, of an elegant writer, appear like the mouldering stones of an ancient abbey, interspersed among the walls of some more modern, but less *durable* structure.

* * * * *

Boyle commences his preface by apologizing for letting his narrative make its appearance alone, as it is evidently a continuation of a larger discourse, but adds, that it is an independant narrative, “ *which (says he) if I may so speak,*
stands

stands upon its own legs, without any need of depending upon any thing that was delivered before, and therefore I think it no great venture, or incongruity, to let it come abroad by itself."

He seems to imagine the gold to have suffered a still greater *deterioration* than is represented in the narrative where it is spoken of as appearing like an imperfect metal, "*only ; yet to tell the truth (says he) I think it was more imbas'd than so.*"

He then proceeds to the relation itself : — *Pyrophilus*, by which name he usually meant himself, rises in a circle of *Virtuosi*, and informs them that he is about to relate an experiment which may tend to persuade them of the possibility of transmutation ; especially when added to the preceding discourse, (which with Bayes, we are to suppose has passed in the Green-room) but adds that its result was not improving, but degrading Gold.

A certain *Simplicius*, who appears as a *Thersites* among these *chymical* heroes, starts up with an objection, that appears to be introduced, only that it may be answered by *Aristander*.

Pyrophilus then "*perceiving by several signs that he needed not to add any thing of apologetical to what Aristander had already said to him,*" resumes his discourse ; in which he labours to remove the objections that are "*wont to be framed against the possibility of metaline transmutation, from*

the authority and prejudices of Aristotle" which he however adds, need not be "*solemnly discussed.*"

The regularity of narration may here be interrupted, to remark, that however unnecessary such solemn discussion may appear in the present *Æra* of Philosophy, it was frequently requisite in the time of Boyle. He had many a noxious weed, grown rank with age, to remove from the field of Science, before he could proceed in its cultivation. And those who now are employed in raising the pile, should look back with reverential gratitude to him, who removed the rubbish from its base.

The Author, it may here be thought, like *Pyrophilus* in this part of his speech, must have had occasion for "*a short pause to take breath;*" and the reader is probably inclined like Boyle's in *Cratippus*, to wish *that he would hasten towards the Historical part of his discourse.*

Pyrophilus proceeds to relate, that meeting at the lodgings of one of his friends, with a stranger who had visited very remote oriental countries, he learned from him in the course of their conversation, that the Chemists of the East, though more reserved, were not less skilful than those of Europe: in confirmation of which he presents Pyrophilus with a small piece of paper folded up, and takes his leave. Pyrophilus who *by no means regards this paper as* (containing) *a trifle*, is scarcely "*consoled*" by it for the loss of this *Virtuoso's* company, which he much "*resents.*"

He however prepares to use the substance contained in
this

this paper, according to some obscure directions which the *travelled ſcavant* had haſtily given : and takes a witneſs or two, and as an aſſiſtant “ *an experienced Doctor of Phyſic very well verſed in the ſeparating and coppelling of Metals.*” —For this caution he is much commended by Heliodorus, who it appears afterwards, “ *did worthily ſuſtain the dignity he had of preſiding in that choice company.*” Pyrophilus continues his narration, after profeſſing it to be his opinion, “ *that cautiousneſs is a very requiſite qualification for him that would ſatisfactorily make curious experiments ; and particularly, in this whoſe event he thought would prove odd enough,*” and leſt his aſſiſtant’s preception ſhould be miſſed by previous information, ſo as to make him fancy he really ſaw, what he had been told he might expect, he reſolves to obviate this prejudication as much “ *as he innocently could,*” and only informs him that he expects a ſmall proportion of powder preſented him by a foreigner, would render Gold extremely brittle. He then opens the paper and finds in it a very ſmall quantity of a dark red powder, which they eſtimate (without weighing, to avoid waſte) at the tenth, or at moſt the eighth part of a grain. They next weigh out in “ *differing*” Balances two drachms of Cupel’d and quarte’d Gold ; which they fuſe in a new and well annealed crucible : on this Gold, when fuſed, the powder is projected and the fuſion continued for a quarter of an hour ; after which the Gold is poured out into another annealed crucible, and ſuffered to cool.

In the fire it had appeared like other fuſed Gold, except that for two or three moments the aſſiſtant obſerved that it
looked

looked like an opal:* but when cold, though exactly of the same weight as before the fusion, instead of Gold, was found “a lump of metal of a dirty colour, as it were overcast with a thin coat, like half vitrified litharge, with a little globule of metal, not yellowish, but like coarse silver; and the bottom of the crucible was overlaid with a vitrified substance, whereof one part was of a transparent yellow, and the other of a deep brown, inclining to red; and in this vitrified substance were plainly to be perceived several Globules, more resembling Silver than Gold in their appearance. The larger piece of metal rubbed on the touchstone and its mark compared with those from a piece of Gold and a piece of Silver coin, it was found to be “*notoriously*” more like the touch of Silver than that of Gold.

The lump being struck with a hammer was found brittle and flew into several pieces: and the internal surface of these was of dirty colour like that of brass or bell metal.

One drachm of this degraded Gold, being cupel'd with about six times its weight of lead, required nearly double the usual time to compleat the operation; which being ended, the cupel was found smooth and entire, tinged with a fine purplish red,† and beside the refined Gold there lay on the cavity of the Cupel, some dark coloured recrements, which were supposed to have proceeded, not

* Any Gold in a certain heat, if there be a slight draught of air over its surface, will have this appearance: even Silver and Copper sometimes present a similar one.

† The colour usually communicated by vitrified Gold.

from the lead, but from the deteriorated metal. On weighing the refined Gold it was found deficient by seven grains. This deficiency was supplied by the abovementioned recrement ; whose weight and fixity, notwithstanding their appearance of impurity, indicated their being Gold : it was unfortunate that the smallness of them, and Pyrophilus and his assistant's want of leisure, prevented this from being duly ascertained.

That no doubt might remain respecting the Gold employed ; a drachm and a half, intentionally reserved out of the parcel of which the debased Gold had been a portion, was melted by itself, and found to be, as was expected “ fine and well coloured Gold.”

Pyrophilus confesses he did not try what effect Aq. Fortis would have on the debased Gold, he not being provided with any whose purity he could rely on : this however he was “ *the less troubled at*” because he knew that Gold, alloy'd with Silver or some other metals, in certain proportions, would protect them from the action of the Nitrous acid.*

The metal having been hydrostatically weighed, its Specific Gravity was found to be to that of water, only as *fifteen* and two thirds to one.

* Brandt's experiments correlative to this are well known. The phenomena observed by Boyle and Brandt are similar to those presented by almost any alloy of metals requiring different solvents.

This "*examen*" (by which he means not a *swarm*, but an examination) added to the other experiments, has justly great stress laid on it by Pyrophilus (Boyle) who observes that to Hydrostatical trials *he* is "not perhaps altogether a stranger."—Specific gravity is above all other properties the least equivocal mark of identity or diversity in metallic bodies : and by what means soever we may conceive the powder to have acted on the Gold in making it brittle, less splendid, or calcinable, we must allow this alteration in Specific Gravity, to be by far the most wonderful effect of the projected powder.

The objections of Dr. Lewis * cannot be properly applied to this effect of the experiment : and scarcely to the others : for though Gold may be rendered brittle by Tin, or even by its vapour, (as is said) and its colour altered by a small proportion of other matter (as is also *said*) yet what known substance will alter so considerably its Specific Gravity?—It was on account of this circumstance, principally, that the present narrative was prefixed to a relation of experiments in which the Specific Gravity of a Metallic substance was changed by a minute proportion of a powder ; and in a very small space of time :—a change in this particular, in Fixity, and in the capability of being calcined or vitrified, are the most certain marks of the Conversion of a perfect into an imperfect metal, and the reverse of them of the contrary.

The auditors of Pyrophilus appear to have paid great

* In his notes on Neumann and elsewhere.

attention,

attention, and to have received much pleasure from the “recital of this *notable circumstance* superadded to the rest”, for “*the Generality of them and the President too*” express themselves to be “*delighted as well as surprized by looking and smiling*”:—after their “*murmuring*” is a little over, the *worthy and eloquent* President, returns the thanks of the company to Pyrophilus, in a speech of which the reader will easily pardon the omission: this is followed by another from Cratippus, in which he demands why “it should not be *lawful* for Philosophers to prize such a lump of depraved Gold, before the finest Gold the Chymists are wont to afford us”, and compares, or rather prefers, this *lump* to the medals whose value is derived from their perpetuating some conquest; as this deteriorated Gold does the victory of art over nature.

Pyrophilus on being requested by the Company to favour them with his reflexions on the theory of his process, replies; that he has only had “some *raving* thoughts about this *puzzling* subject” and declines the task. Heliodorus then urges him to “draw some inferences and so to conclude”—He then observes, that in his experiment a change altogether as wonderful as that said to be occasioned by the PROJECTION of the Alchemists, has really been produced:—That Gold, the most homogeneous and immutable of metals, may in a very short time be exceedingly changed in malleability, colour, homogeneity, and in that which as he justly observes is beyond all, in specific gravity; and all this by only one *thousandth* part of its weight of another substance.

If any credit be given, and surely the highest is due, to Boyle,—the author of the experiments on Mercury, which are next to be related, may hope to derive some sanction from his authority : — compared with Boyle's experiment the *marvellous* of his sinks into the probable : Nay more, —if Boyle's experiment be credited, and who will refuse his assent ? let it be remembered, that it was made but once, before three or four persons at most : what then shall be said to processes, often repeated, before numerous spectators ?

To conclude this abstract already too long ; let us deduce from it the following Inference, which shall be given in the words of BOYLE, for whom the author, notwithstanding his having amused himself with the quaintness of his language, entertains the greatest veneration.

The quotation has already been placed on the back of the inscription, as a more diffuse *motto*, but may be repeated here, as it cannot be too strongly impressed.

“ We may (says Boyle) among other things, learn from our experiment this lesson ; That we ought not to be so forward as many men otherwise of great parts are wont to be, in prescribing narrow limits to the power of Nature and Art, and in condemning and deriding all those that pretend to, or believe, uncommon things in Chymistry, as either cheats or credulous.”

EXPERIMENTS

EXPERIMENTS

ON

MERCURY AND SILVER.

EXPERIMENT I.

Made May the 6th, 1782. before the Rev. Mr. Anderson; Capt. Francis Grose; Mr. Russell, and Ensign D. Grose. The Gentlemen mentioned in the Introduction as the most proper witnesses of the process, then resident in the town.

HALF an ounce of Mercury provided by Capt. Grose (bought at an apothecary's of the town) was placed in a small hessian crucible, brought by Mr. Russell on a flux composed of Borax, (also brought by him) a small piece of charcoal, taken out of a scuttle (fortuitiously) by Mr. D. Grose and examined by the rest of the company, and a small piece of Nitre also taken out without selection, by the Rev. Mr. Anderson, from a quantity in common use, in the Laboratory; these being pounded together in a mortar which all the company had previously inspected, were pressed down into the crucible with a

small pestle: on this flux the mercury was poured by Mr. Anderson, and upon it half a Grain, carefully weighed out by Mr. Russell, of a certain powder, of a deep red colour, furnished by Dr. P. was put on it by Mr. Anderson.

The crucible was then placed in a fire of a moderate red heat by Dr. P. who from his greater facility in managing the fire from long habit, was thought most eligible to conduct the experiment. He repeatedly called the attention of the company to observe the stages of the process, and to remark in every part of it that any voluntary deception on his part was impossible.

In about a quarter of an hour, from the projection of the powder, and the placing the crucible in the fire, he observed to the Company, who on inspection found his observation true, that the mercury, though in a red hot crucible, shewed no signs of evaporation, or even of boiling: the fire was then gradually raised, with attention on the part of the company, and repeated calls for that attention from Dr. P. that no undue addition might be made to the matter in the crucible; in a strong glowing red, or rather white-red, a small dip being taken on the point of a clean Iron Rod, and when cold, the *scoria* so taken and knocked off, were shewn to the company and found replete with small globules of a whitish coloured metal, which Dr. P. observed to them could not be Mercury as being evidently fixed in that strong heat: but as he represented to them an intermediate substance between φ and a more perfect metal.

A small

A small quantity of Borax (brought by Mr. R.) was then injected by him and the fire raised, but with the same precautions on the part of Dr. P. to subject every thing to the minute inspection of the persons present; and after continuing it in a strong red-white heat for about a quarter of an hour, the crucible was carefully taken out, gradually cooled: on breaking it, a globule of yellow metal was found at bottom, and in the scoriæ smaller ones, which collected and placed in an accurate ballance by Mr. Russell, were found to weigh *fully* Ten Grains. This Metal was in the presence of the above mentioned Gentlemen sealed up in a phial, impressed with the Seal of Mr. Anderson, to be submitted to future examination, though every one present was persuaded that the metal was gold.

The seal being broke the next morning, in the presence of the former company, and of Captain Austen, and the metal hydrostatically examined, the weight of the larger globule (the others being too minute for this mode of examination) was found to be in air 9 Grains and a Quarter, and in distilled water of temp. Fahren. 50 plus, it lost, something more than $\frac{3}{8}$ (but not quite an half) of a grain: the difference was not appreciable, as no smaller weight than the eighth of a grain was at hand, but was judged by all the company to be nearly intermediate; i. e. $\frac{7}{16}$:—at half a grain the sp. gr. would be rather more than 18:1; if only $\frac{3}{8}$ were lost in water the sp. gr. would exceed 24:1. the intermediate would be $21\frac{1}{7}$ nearly; but as the loss seemed rather more than the intermediate, though apparently and decided less than half a grain, the specific gravity

vity must have been nearly as 20 : 1. and in this estimate all present acquiesced.

After this hydrostatical examination, the globule was flattened by percussio into a thin plate, and examined by Mr. Russell in the manner of artists for commercial purposes; on finishing his scrutiny he declared it to be as good gold as the grain gold of the *refiners*, and that he would readily purchase such gold as that which he had just examined at the highest price demanded for the purest gold.

The plate being then divided, one half was before the company sealed up by Mr. A. to be submitted to a trial of its purity, which Dr. P. proposed, requesting his friend, Dr. Higgins, of Greek Street, to make; the remainder being put into Aq. Regia of Nit. acid and Sal. Ammon. afforded a solution sufficiently rich, before the company separated, to yield with sol. of Tin, a richly coloured crimson precipitate.

Capt. G. was accidentally absent when the precipitate was made, but saw it next day. In about four hours the portion of metal employed was completely dissolved, and the next morning before Capt. and Mr. D. Grose, and Mr. Russell (Mr. A. being prevented from coming.) The solution being divided into three portions the following experiments were made.

To the first portion, diluted with water, was added a quantity of Caustic Vol. Alk. and the precipitate, which was copious, being duly separated and dried, about a grain
of

of it, placed on a tin plate, was heated and found to explode smartly; this experiment was repeated three times.

To the second portion, diluted, was added a portion of Sol. of Tin, in Aq. Reg. A beautiful crimson coloured precipitate was immediately formed in considerable quantity; which when dried, was mixed with a fusible fritt, composed of flint-powder, and the fluxes proper for the Ruby Glass of Cassius, in the proportion of 5 Grains of the precipitate to 3ij of the frit, and in a vitrifying heat afforded in about three hours a transparent glass, which by heating again, assumed an elegant crimson colour: and the remainder which continued in the fire also acquired a bright red colour.

The third portion being mixed with vitriolic Ether, imparted to it the yellow colour given to this fluid by solutions of Gold: and the Ether being evaporated in a shallow vessel, a thin purplish pellicle adhered to the side, spotted in several places with yellow.

Dr. Higgins soon after receiving the piece of Metal, favoured the Author with an answer, in which he notified that the packet came to him under the proper seal:—That he was well satisfied of the *purity* of the gold he received; and that he considered the authors experiments as exclusively sufficient to have ascertained the nature and purity of the metal.

E X P E R I M E N T II.

Made at Dr. Price's, May 8th, 1782, before Sir Philip Clarke, Dr. Spence, the Rev. Mr. Anderson, Capt. Grose, Mr. Ruffel, and Ensign Grose.

HALF an ounce of Mercury, procured from one Mr. Cunningham an Apothecary of the town, was placed on a flux composed of an ounce of powdered Charcoal, two drachms of Borax and one scruple of Nitre, and on it when a little warmed was projected one grain of a white powder, furnished by Dr. Price.

After the Crucible had acquired a red heat, the Company all saw the Mercury lying quiet at the bottom, without boiling or smoking in the least, and it continued in this tranquil state after it had gained a full red heat. It was continued in a fire gradually augmented to a white heat, near three quarters of an hour, a smaller crucible *previously inspected*, being inverted on it, to prevent coals from falling in: and the crucible being then withdrawn and cooled, many globules of white metal were found diffused through the whole mass of scoriæ: of these globules were collected to the weight of ten grains, before the company separated, and consigned to the care of Mr. Ruffel, who took them away with him.

Part of the remaining globules being afterwards collected,

ed by pounding the crucible and washing over the powder, the whole melted together amounted to thirteen grains.

Dr. Price remarked on this process, that having taken too great a quantity of Charcoal, the globules were thereby dispersed over the whole mass, and the powder having been sprinkled against the sides of the crucible had not produced its greatest effect. And that some of the Mercury which had escaped its action must have been volatilized by the heat ; and this on inspection of the covering crucible was found to be true. The Experiment was therefore the next morning repeated in presence of Mr. Anderson, Capt. and Ensign Grose and Mr. Ruffel.

E X P E R I M E N T III.

THE remaining half ounce of Mercury was employed ; the charcoal and borax both taken without selection from large quantities in the laboratory, were powdered by Ensign Grose, and the Mercury charged in the crucible as in the former Experiment.

Barely half a grain of the White powder, weighed out by Mr. Ruffel, was projected on the Mercury, which by some accidental delay had begun to boil in the Crucible ; but on the application of the powder the ebullition ceased, although the crucible and contained Mercury was subjected to a *much greater* heat ; and it continued without boiling, even when of a red heat. The Crucible was gradually
D heated

heated to a white heat, and when cooled and broke, there was found in the bottom a well collected bead of fine white metal, weighing four Grains.

E X P E R I M E N T IV.

ON the same day, and the same persons being present as at the preceeding experiment, the following was made on Silver.

Mr. Russell weighed out fixty grains (one Drachm) of Grain Silver, which he had purchased of Mess^{rs} Floyer and C^o, refiners in Love Lane, Wood Street, Cheapside; this quantity was placed in a small Crucible on some of the flux made as above, before the Company, by Ensign Grose; and on the Silver, when in fusion, was projected a bare *half grain* of the Red powder, used in Experiment the first. The crucible was then replaced in the fire, and continued there for about a quarter of an hour; a piece of Borax, taken at a venture, out of a jar containing a large quantity, was thrown on the metal by Ensign Grose.

Dr. Price soon after, from the appearance of the flux imagining the crucible to be cracked (by the cold and moisture of the borax) took it out of the fire, and finding that what he suspected had happened, did not replace it; when cool it was broke, and the button of Metal was found in the bottom, which when weighed, appeared not
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to have lost any of its original weight, so that fortunately only the flux had transfused.

E X P E R I M E N T V.

T H A T no doubt might arise from the failure of the Crucible in the last Experiment, a similar one was made in the presence of the same persons, with the addition of J. D. Garthwaite of ——— Esq; who was also present at the latter part of Experiment IV.

Thirty Grains of the abovementioned Grain Silver was by Mr. Russell weighed out, and put into a small Hessian Crucible, on a flux of Charcoal and Borax made before the Company, with the same precautions as in Experiment I. On the Silver when fused, was projected by Mr Anderson a bare *half grain* of the Red powder, and about five minutes after, some Glass of Borax (to avoid the moisture contained in crude Borax) was thrown in by one of the Company. The Crucible after being kept in a red-white heat for about fifteen minutes was taken out, and when cold broke: at bottom of the scoriæ or rather flux, which in this Experiment was neatly fused, lay the button of metal which was found *nearly, if not exactly, of its original weight.*

It was then tried by Mr. Russell in the artists manner; as was also the piece of metal obtained in Experiment IV. He found *both* of them to contain gold; the latter in lar-

ger quantity, as might be expected, from the relative proportion of the powder and Silver in the two Experiments.

Dr. Price also examined the metal on the touch-stone, (Bafaltes) and with Nitrous acid; when all the company saw the mark of Gold remaining, while a mark from a piece of the very parcel of grain Silver from which the portion used in these experiments had been taken, and placed by the side of the mark from the graduated or enriched Silver, totally vanished on wetting it with the Aqua Fortis.

The mark from the enriched silver remained (of a yellow colour) after repeated affusions of weak and strong Aqua Fortis. So that the Company were entirely convinced that Gold was now contained in the fused Silver.

The Chemical reader will probably anticipate Dr. Price's observation;—that of the known metallic substances of a Gold colour, Sulphurated Tin, could not without decomposition, have sustained the heat employed in these experiments; and that Copper, or Regulus of Nickel, would have been dissolved by the Nitrous acid, equally with the Silver. The remark is indeed scarce necessary; for had it been possible to have secretly introduced into the Crucible any of these metals, (and none of the Company would for a moment tolerate the idea of such an attempt having been made by the operator,) the identity of weight observed was sufficient to prove that nothing but the crimson powder had been added.

After

After the pieces of metal had been thus separately examined, they were melted together, and when cool it was remarked that the surface of the culot of metal was elegantly radiated with alternate striæ and furrows; an appearance not usual in fused Silver. Ten grains were reserved by Dr. P. for his own examination; and the other 80 grains were taken by Mr Russell, to be assayed in the refiners' manner.

Dr. P. found the proportion of Gold to be $\frac{1}{8}$ of the of the whole mass.

Mr. Russell in the course of a few days caused all the abovementioned Gold, Silver, and mixture of Gold and Silver, to be assayed in the artists' manner, for the refiners, at the office of Mess^{rs} Pratt and Dean, Assay-Masters, near Cheapside.

They assayed each portion separately, and reported the Gold and Silver to be of the most compleat purity: and the enriched Silver to contain Gold in the proportion of one eighth of the joint weight: and this report he also repeated before the Spectators of Experim. VII. on May 25.

It was remarkable that both the refiner and Assay-master *at first* affirmed the impossibility of success in the process; and prejudiced by received opinions, questioned the purity of the metals, though they owned they *looked* much like ordinary Gold. The assay instantly dissipated their doubts; and they owned with astonishment, that the metals were
entirely

entirely pure, and certified their purity in their official report.

EXPERIMENT VI.

Made May 15, 1782, before Sir Philip Norton Clarke, the Rev. B. Anderson, Capt. Grose, Dr. Spence, Ensign Grose and Mr. Hallamby, and several times repeated before Mr. Anderson, Dr. Spence and Ensign Grose.

TWO ounces of Mercury were, by one of the company, taken out of a Cistern in the Laboratory, containing about two hundred weight of Quicksilver (for experiments on the Gasses) and in a small Wedgewood's-ware Mortar rubbed with a drop or two of Vit. Ether: on this Mercury, which was very bright and remarkably fluid, barely a grain of the white powder, was put, and afterwards, rubbed up with it for about three minutes.

On pouring the \propto out of the Mortar, it was observed to have become blackish and to pour sluggishly; after standing ten minutes, on being poured out of the vessel in which it had stood, it was found considerably less fluid than before; and in a quarter of an hour's time so increased in spissitude as hardly to pour at all; but seemed full of lumps. Being now strained through a cloth, a substance like an amalgam, of a pretty solid consistence, remained behind; the unfixed mercury being expelled from this mass, by placing it on charcoal and directing the flame of
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of a lamp on it with a blow-pipe, a bead of fine white metal remained fixed in a strong red heat; which by every subsequent trial appeared to be silver: the weight of the bead thus collected, weighed and examined before the company separated, was 18 Grains: but much remaining in the strained Mercury, this was afterwards separated and weighed 11 grains; the whole obtained was therefore 29 grains, or an increase in proportion to the powder as 28 : 1.

Five drachms of Mercury taken out in the same manner as the above two ounces, were rubbed up with Vit. Ether, and afterwards with barely a quarter of a grain of the Red powder; a mass like an amalgam being obtained by straining it after it had stood about a quarter of an hour, and the unfixed and untinged Mercury driven off before the blow-pipe, as in the former Experiment, a bead of yellow metal remained, weighing 4 grains; and after standing some time longer, Gr. 2 and $\frac{1}{4}$ more were obtained, both which resisted Aqua Fortis on the touch-stone; and a small quantity being dissolved in Aqua Regia, a purple precipitate was produced from the Sol. by the Sol. of Tin and a brownish one by Sol. Ferri Vitriolati, Bergm. (Green Vitriol or Copperas;) in this Experiment therefore the increase of Gold, was to the powder employed, as 24 : 1, exclusive of the weight of the powder.

The former part of this Experiment was repeated on Saturday the 18th day of May, before the Rev. Mr. Manning, the Rev. Mr. Fulham, the Rev. Mr. Anderson, the Rev. Mr. Robinson and Dr. Spence.

Two ounces of Mercury, treated as before mentioned, (after exhibiting phænomena similar to those above related) afforded a mass, one half of which only (to avoid the noxious Mercurial fumes of the whole) after having the Mercury expelled from it by a white heat before the blow-pipe, yielded upwards of twelve grains of a white metal, that in every trial to which it was submitted, appeared to be Silver.

The product therefore, including the Silver contained in the strained Mercury would have been nearly as 28 : 1 ; as in the former Experiment.

A small portion (about 3ij) of the above Mercury being put into another vessel, and about the sixth of a grain of the red powder put on it, the Mercury after being ground up with it, and standing some time, was strained as the former, and the small mass so obtained, placed before the blow-pipe. It yielded something more than a grain of Metal, which examined by Nit. acid on the Touchstone, evidently contained Gold; as was apparent to the Company before their leaving the Laboratory. It was intended to have been submitted to other trials, but from its minuteness and form, was accidentally lost.

E X P E R I M E N T VII.

Made Saturday May 25th, 1782, in the presence of The Lords Onflow, King and Palmerstone, Sir Robert Barker, Sir Philip N. Clarke, Bart^s, The Rev. O. Manning, B. Anderson, G. Pollen, J. Robinson, Cl^{ks}; Dr. Spence, W^m Mann Godschall, W^m Smith, W. Godschall, Jun^r, Esq^{rs}—Mefs^{rs} Gregory and Ruffell.

3ij Mercury were taken from the Cistern formerly mentioned, and in a similar manner, and rubbed up with a few drops of Vit. Ether, in the small mortar, as in Experiment VI.

A bare grain of the white powder was projected, and afterwards rubbed up with it. The ϕ , which before the addition of the powder had been very bright and fluid, was now perceived by the company to be dull and run heavily: it was poured out into a small glass vessel, and after standing for about 45 minutes, was put into a cloth to be strained. It now poured so sluggishly that the latter portions of it seemed in a state intermediate, between fluidity and solidity, or to use a term less scientific, but like many other vulgar ones, very descriptive, poured grouty.

Great part of the superfluous Mercury being strained off, a mass similar to an amalgam was left in the cloth: and the remaining Mercury which could not be pressed out, being driven off by fire from a portion (about a fourth) of the whole mass, a globule of white metal which had all the appearance of Silver, remained, and was kept in a white heat for about two minutes, before the blow pipe. This globule weighed about 10 grains, so that the whole product,

duct, by means of one grain, would have been found, if collected, to be 40 grains : besides what was left in the expressed Mercury.

On the same day and before the same respectable Company :—half an ounce of Mercury revived from Cinabar, brought by the Rev. Mr. Anderson, was by him placed in a small round English crucible, taken from among a number of others in the Laboratory, by Lord Palmerstone, on a flux composed of a small piece of Charcoal and a piece of borax, both taken casually by some of the company from large quantities, and pounded in a mortar previously inspected by those present.

This flux being pressed down in the crucible with a small pestle, also examined, the mercury was poured into the depression, by one of the spectators, and on it *half a grain*, bare weight, of the Red powder, was put by Lord Palmerstone. The crucible being then covered with a lid taken in the same manner as the crucible from among many others, and shewn round to the company, was placed in the furnace, surrounded by lighted charcoal.

One or more of the Company, particularly the Lords King and Palmerstone, were during the whole time of the Experiment close to the furnace and operator ; and as requested by him gave the closest attention to every part of the process.

When the crucible had acquired a full red heat, the cover was removed, and several of the Company saw the Mercury in a tranquil state, neither evaporating nor boiling : in which state it continued even when the Mercury itself was compleatly ignited. The

The cover being replaced, the fire was gradually raised to a white heat: the crucible being continued in this heat for thirty minutes, was taken out, cooled, and broke.

A globule of Metal was found at bottom, neatly fused, and *exactly fitting* the concavity of the divided scoriæ. This globule fell out by the blow, among the fragments of the crucible, and was taken up and shewn round to the Company by Lord Palmerstone; and in their presence replaced in the hollow of the vitrified Borax, to which it was accurately adapted.

Many other globules were diffused through the scoriæ attached to the sides of the crucible, fragments of which were distributed among the company at their request.

The bead which lay at the bottom, weighed about ten grains, and was taken away, together with the Silver, by Mr. Godschall; and by him afterwards transmitted to Lord Palmerstone, to be submitted to proper examination.

Mr. Godschall returned the Gold, with the Assay-Master's report on it and on the Silver.

The Assay-Master, whom Mr. G. for greater certainty on this occasion had the precaution to have recommended by the Clerk of the Gold-smith's company, reported both the Gold and Silver to be perfectly pure.

Dr. Price, though well acquainted with the characters employed by Assay-Masters in making their reports (which are peculiar to them) unwilling to rely entirely on his own knowledge, and being desirous to offer collateral evidence to the public, shewed the Gold and the Report to Mr. Lock, an experienced Goldsmith and a Magistrate of the City of Oxford, without informing him of any of the above particulars.

Mr.

Mr. Lock, (before two Gentlemen of Magdalene-Hall who were present) affirmed the metal to be *by the Report* Pure Gold: which he added was confirmed by its appearance: and that it consequently was *superior* to Gold of the English *standard*.

Two Experiments, similar to those made on Saturday May 25th, were repeated on a larger scale, before some of the above company on the Tuesday following; with the same attention on their part, and more on that of the Dr. to the regulation of the fire; which he observed to them, being now less engaged, and his attention not divided, he could employ to produce a much greater effect.

Twelve grains of the White powder produced from thirty ounces of Mercury upwards of an ounce and a quarter, or six hundred grains of Fixed white metal; or in the proportion of 50 : 1.—And two grains of the Red powder, produced from, one ounce of Mercury, two drachms, or 120 grains of fixed and tinged metal; i. e. sixty times its own weight.

These last portions of Gold and Silver, as well as a part of the produce of the former Experiment, have had the honour of being submitted to the inspection of His Majesty; who was pleased to express his royal approbation.

This honour may be mentioned with the less impropriety, as it is conferred by a Sovereign equally revered for his patronage of Science and beloved for his amiable condescension.

T H E E N D.

